

NOTES ON MICRO AND ULTRASTRUCTURE OF “OBERHÄUTSCHEN” IN VIPEROIDEA *

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ABSTRACT: Description of a new technique for microscopical study of “Oberhäutschen; description of a new genus: *Probothrops*; the genera, *Porthidium*, *Bothriechis* and *Bothriopsis* are considered as distinct from *Bothrops*; with a short diagnose of the *Agkistrodonini*, and redescription of *Calloselasma rhodostoma* and *C. annamensis*.

KEYWORDS: “Oberhäutschen; Viperoidea; *Probothrops*; *Porthidium*; *Bothriechis*; *Bothriopsis*; *Agkistrodonini*; *Calloselasma rhodostoma*; *Calloselasma annamensis*.

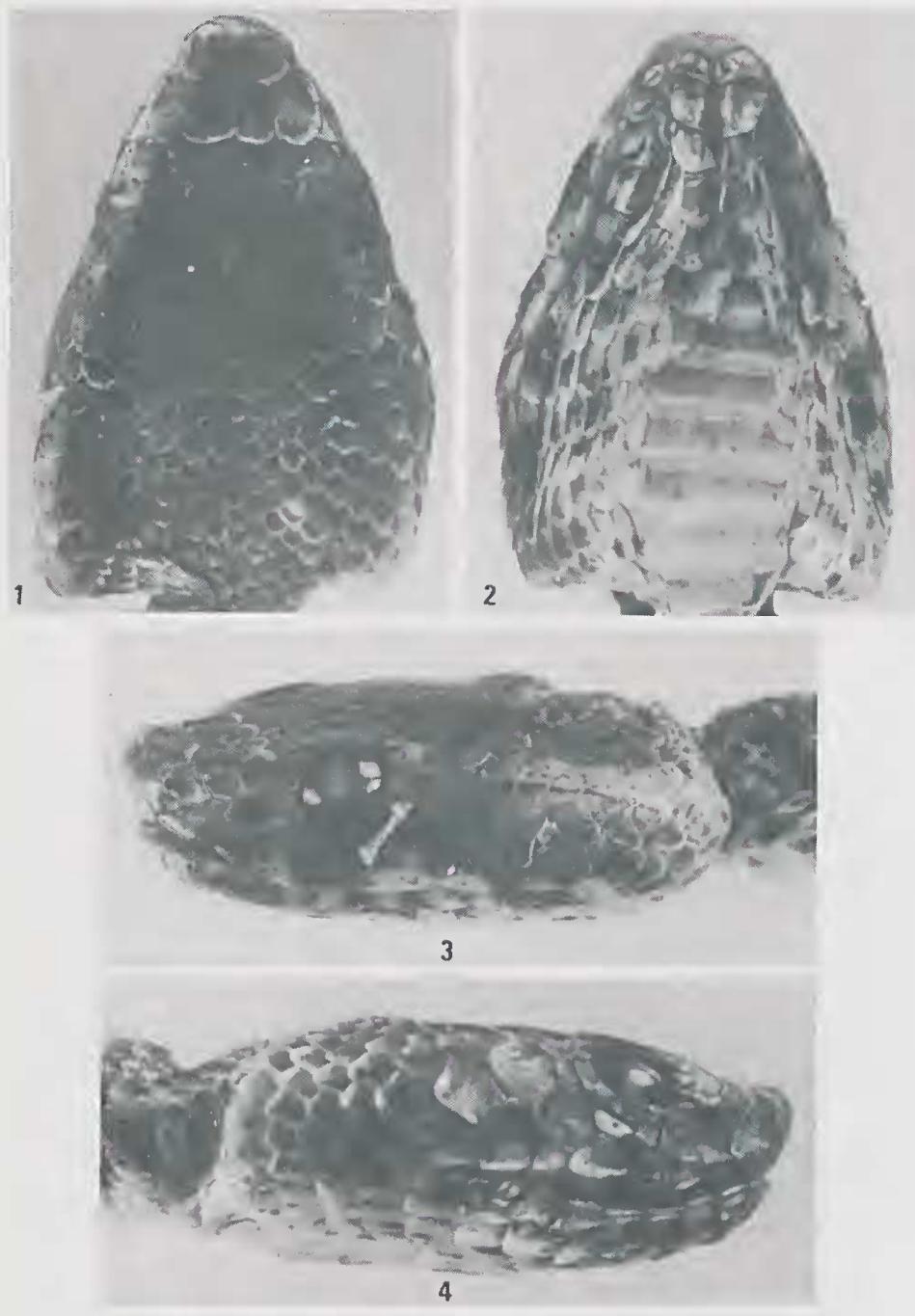
INTRODUCTION

This preliminary account on *Crotalid* snakes is based on the study of a large number of specimens. Besides the classical methods in sistematic zoology, special attention is given to the superficial structure of the skin. In 1953 the Senior author and Souza Santos published a paper on sub-microscopic structure of “Stratum corneum” (oberhäutschen) showing the value of the method in taxonomy. Besides the electron microscopic method a new method for use in optic microscopy is described. The conclusion is that the method is extremely useful. For the moment about 90% of the species from the *Bothrops Trimeresurus* complex were examined. Definitions of the genera will be modified but to avoid useless changes in nomenclature the authors will wait to complete their studies before introducing the changes maintaining for the moment a more conservative nomenclature. The solenoglyphous snakes are included in a superfamily, *Viperoidea* subdivided into two families: *Atractaspididae* for the primitive colubrid-like Mole false vipers; *Viperidae* for the vipers, with four subfamilies: *Viperinae* (true vipers); *Azemiopsinae* (Mole Vipers); *Causinae* (Night adders) and *Crotalinae* (Pit Vipers). The *Crotalinae* are

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Figs.: 1, 2, 3, 4 — *Calloselasma annamensis* holotypus ♀

Mus. Nat. Hist. Nat. n.º 3.323



Fig. 5 — *Calloselasma annamensis* holotypus ♀

Mus. Nat. Hist. Nat. n.º 3.323

divided in two tribes; *Agkistrodontini* for the genera *Agkistrodon*, *Calloselasma*, *Deinagkistrodon*, *Gloydius* and *Hypnale* (Hoge and Romano Hoge, 1981), and *Crotalini* for the genera; *Crotalus* and *Sistrurus* (Rattlesnakes); *Bothrops*, *Porthidium*, *Bothriechis* and *Bothriopsis* (American scale snouts); *Trimeresurus*, and *Protobothrops* (Asiatic Pit Vipers); *Tropidolaemus* (Chin-keeled Pit Viper) and *Ovophis* (The mountain and Okinawan pit viper). The genus *Agkistrodon* "sensu auctores" is considered as formed by five genera: *Agkistrodon* for the American species; *Calloselasma* for *C. rhodostoma* and *C. annamensis*; *Deinagkistrodon* for *D. acutus*; *Gloydius* for the asiatic forms except *Deinagkistrodon*, *Calloselasma* and *Hypnale* for *H. hypnale*, *H. nepa* and *H. walli*.

METHODS

Besides the classical methods in systematic zoology, special attention is paid to microscopic and ultramicroscopic structures of "Oberhäutschchen" Pockrand 1937. (Epitrialschicht of Leydig 1873, "stratum corneum" of Hoge et Souza Santos, 1953). Direct optical examination of "oberhäutschchen" is very difficult due to the thickness of the preparation. A new technique of replica is used for examination with optical microscope. Instead of making replicas by the "striping method" (Schaffer 1943) the replica was done directly on the slide. The slides are from Plexiglas, a drop of chloroformium is placed on the plexiglas and the snake scales are pressed against leaving a perfect replica of the scale. This preparations can be stored indefinitely unlike the ones by the dry-striping method. The examination of the replicas was made with the help of a Siemens electron microscope type UM 100 b at original magnifications of 1300 and 6300.

STRUCTURE OF "OBERHÄUTSCHEN"

Comparing the microscopic, and or, the submicroscopic structures of *Bothrops* and *Trimeresurus* (fig. 27, 28, 51 and 52) it is easy to distinguish them on the base of their pattern.

The very large number of species already examined permit us to conclude that very distinct patterns permit the use of this structure for the distinction of genera for ex.: *Boa*; *Xenboa*; *Eunectes*; *Corallus*; *Lystrophis*; *Conophis*; *Ditaxodon*; *Python* etc. (figs. 31 to 39 and 44, 45).

Between Viperidae the distinction of: *Atheris*, *Echis*, *Vipera*, *Bothrops*, *Trimeresurus*, *Tropidolaemus* etc. is possible on the base of the ultrastructure.

A very large number of genera and species are already examined and the results will be published in a forthcoming paper.

Here we will limit us to a few genera and species of *Crotalinae*.

Using the replicas prepared for optical microscopic examinations the shape of cells and microornamentation is easily observed (fig. 46 and 62).

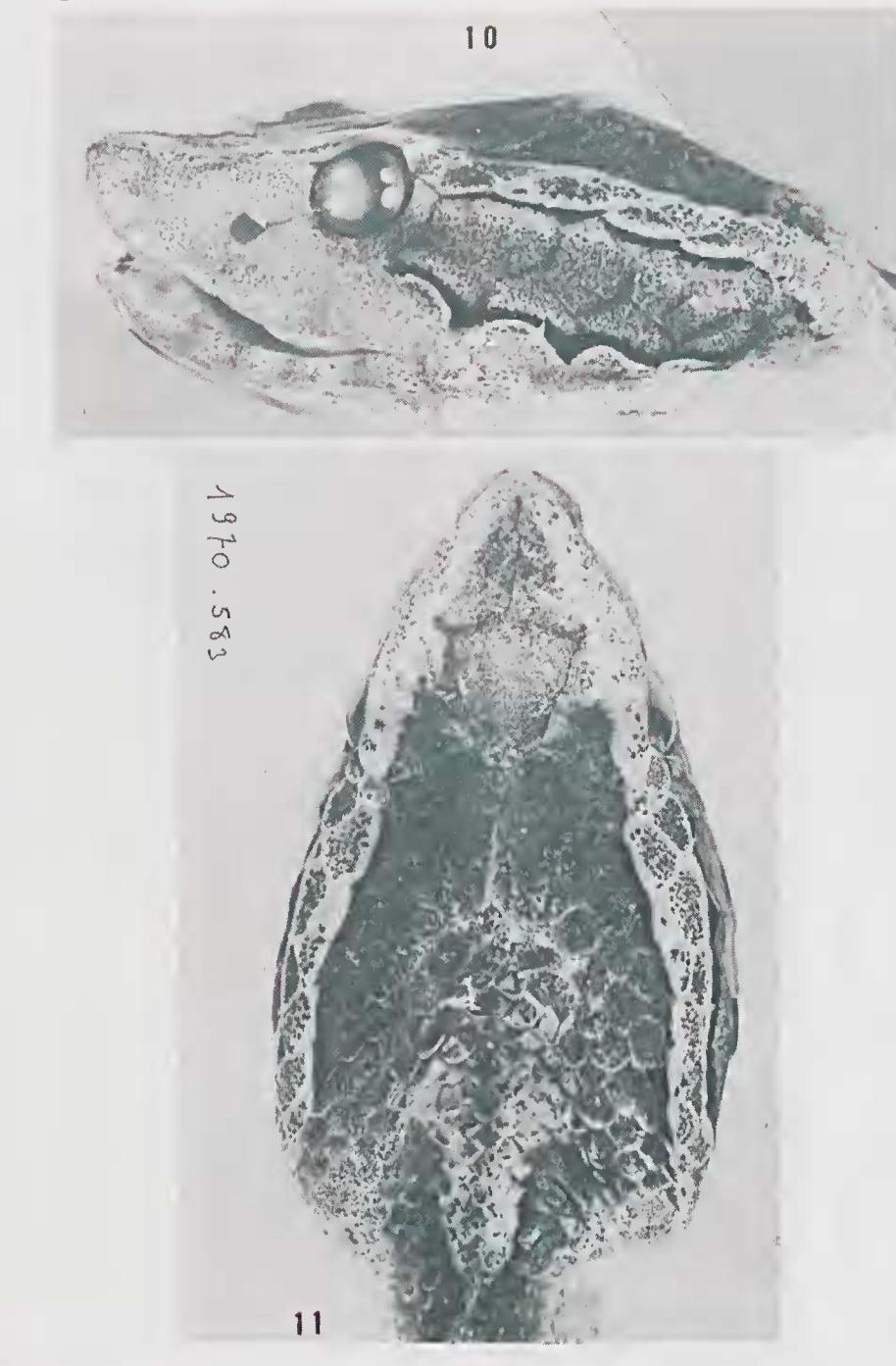


Figs. 6 and 8 — *Calloselasma annamensis*

Mus. Nat. Hist. Nat. n.º 1920 — A 215

Figs. 7 and 9 — *Calloselasma rhodostoma*

Mus. Nat. Hist. Nat. n.º 1970-583



Figs. 10 and 11

Calloselasma rhodostoma

Mus. Number: MNHN n.º 1970 — 583

Locality: Plantation Krek, Cambodge

Collector: Saint Giron

Before discussing the results it seem interesting to observe that, sometimes different patterns appears in the same genus (*sensu auctores*) but till now the different patterns are always associated with other characters.

Although the use of the scanning microscopic give the best results, the optic technique here described, is very usefull, simple and permit a quick observation.

Bothrops: a pattern of allongated and generally keeled cells (fig. 51 and 27 and 29).

Trimeresurus: a pattern of large, not or nearly not allongated cells (fig. 28 and 52).

Tropidolaemus: a pattern of rounded cells, strongly covered with complicated keells and stripes (fig. 53 and 58).

In *Ovophis* the pattern observed (only *O. okinavensis* and *O. chaseni* studied) is quite similar to *Trimeresurus* (fig. 62).

A distinct pattern was observed in *flavoviridis*, *mucrosquamatus* and *jerdoni*. This pattern together with other characters permit to put them in a distinct genus.

Probothrops Gen. Nov.

DIAGNOSIS

A pit viper with allongated, not forked, and generally edentulous palatine (fig. 80). The maxillary without the projection on border of cavity, similar to *Bothrops*; the anterior border of ectopterigoid not enlarged as in *Trimeresurus* and *Ovophis*. Splenial and angular distinct; structure of paraventral with fingerlike projections; structure of dorsals showing a striated pattern (fig. 41). The median wing of the prefrontal, unlike in *Trimeresurus* and *Tropidolaemus*, present, but small in size.

RELATIONSHIP

Related to *Bothrops* by the pattern of paraventral structure (fig. 42). Easely distinguished from *Trimeresurus* by the structure of dorsals, paraventrales (fig. 40 and 41); the different shape of palatine, maxillary, ectopterygoid, and prefrontal (figs. 80, 81).

Type species: *Probothrops flavoviridis*.

Species here considered as belonging to the genus *Probothrops*: *P. flavoviridis* (Hallowell 1860); *P. jerdoni* (Günther 1875) and *P. mucrosquamatus* (Cantor, 1839).

Bothrops

The genus *Bothrops* as here defined can be characterized by:

Palatine deeply forked (fig. 68), internal border of maxillary not provided with projection; ectopterygoid with anterior part not large and square; splenial and angular present; structure of dorsals showing allongated and keelled cells (figs.: 75, 27, 29 and 55).



Figs. 12 and 13

Calloselasma annamensis Angel

Locality: Cap. Saint Jacques, Sud Vietnam

Mus. Number: MNHN — 1920 A 215

Col.: Mignon.



Fig. 14

Calloselasma annamensis

Locality: Plantation Krek, Cambodge

A few species of *Bothrops* "sensu auctores" do not share all those characters: *undulatus*, *bicolor*, *schlegeli*, *lateralis*, *nigroviridis*, *nummifer* and *lansbergii*.

Although more data has to been computed before further subdividing the *Bothrops* group a few genera can already be revalidated.

Porthidium Cope

This genus related to both *Bothrops* and *Trimeresurus* differs from *Bothrops* by the structure and ultrastructure of dorsals which are closely related to the ones observed in *Trimeresurus* (fig. 46).

From *Trimeresurus* by shape of maxillary and ectopterygoid which are similar to the ones observed in *Bothrops* (figs. 66, 72).

The shape of palatine is somewhat intermediate between *Bothrops* and *Trimeresurus*. Differs from *Bothrops* and *Trimeresurus* by having splenial and opercular fused (figs. 70 and 76).

The genus *Porthidium* as here defined is different from Burger's conception of the genus. Burger states that all but *nasutus* have splenial and angular separated. The specimens of *lansbergii* examined all have splenial and angular fused.

Type species: *Porthidium lansbergii* (Schlegel), 1841.

The following species are included in this genus: *P. brachystoma*, *P. dunnii*, *P. nasutus*, *P. ophryomegas*, and *yucatanicus* (not seen).

Bothriechis Peters

This genus already recognized by Savage is really different from the genus *Bothrops* by the structure of "oberhäutschen" (fig. 57).

Type specimens: *Bothriechis nigroviridis* species here included in the genus

B. nigroviridis subsp. (including *rowleyi*?).

Bothriopsis Peters

This genus already recognized by Burger is here restricted to *B. castelnaudi* and *B. lichenosus*.

Diagnosis will be given in a forthcoming paper.

Type species: *B. castelnaudi*.

Species here included *B. castelnaudi* with *B. lichenosus* either as a species or subspecies.

Genera *inquerendae*

undulatus, *bicolor*, *schlegeli*, *lateralis*, *pictus*, *nummifer*, *supraciliaris*, till now in the genus *Bothrops* "sensu auctores". Some species, specially *bicolor*, are closely related to *Trimeresurus*. (Fig. 43).

The species *T. kaulbacki* and *T. kanburiensis* still need to be studied. *T. capitetriangulatus* although having the maxillary and palatine of the *Trimeresurus* shape, a distinct striped pattern of dorsal scales the shape of ectopterygoid also is quite unusual. More specimens are needed before conclusion.

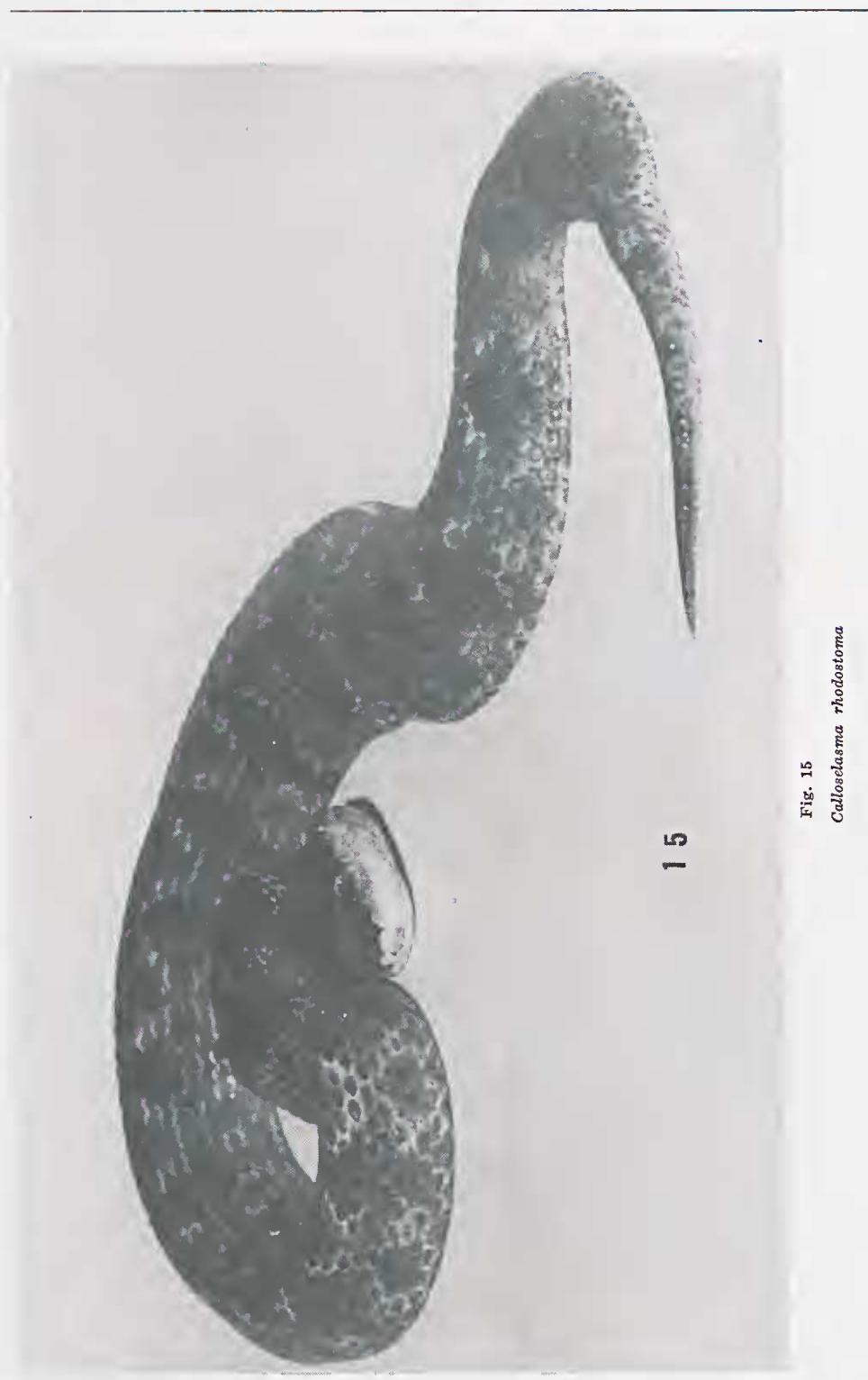


Fig. 15
Calloselasma rhodostoma

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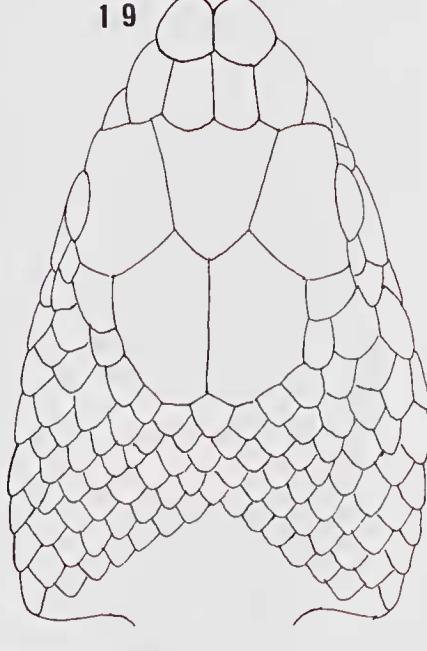
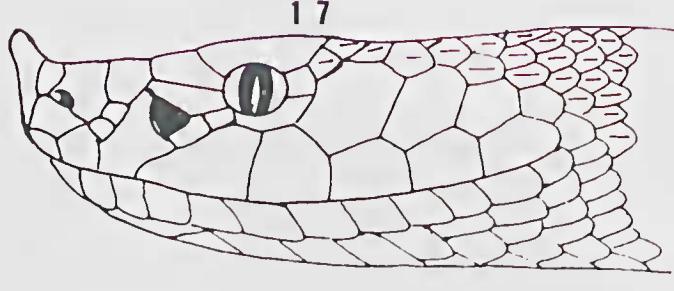
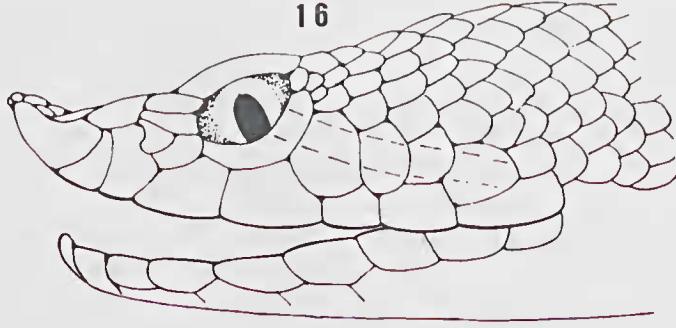


Fig. 16 and 18 — *Hypnale nepa* ♀ — MNHN Paris — N.º 4.042

Fig. 17 — *Deinagkistrodon acutus*

Fig. 19 — *Calloselasma annamensis* type

Agkistrodontini (Historical)

In 1896 Boulenger included in the same genus *Agkistrodon* the genera *Hypnale* Fitzinger, 1843, *Halys* Gray, 1849 (non Fabricius, 1803) and *Calloselasma* Cope (nom. nov. pro *Leiolepis* Duméril, 1853) (non Cuvier, 1829), nearly no attempt was made for the revival of those genera, except by:

1957 Chernov who removed *Calloselasma* from the synonymy and gave additional reasons for the revival of the genus.
Unfortunately he was not followed by the authors.

1971 Burger in his doctor thesis (l.c.) revived *Calloselasma* and *Hypnale*. Burger used *Agkistrodon* for the American species, *Calloselasma* for the species *rhodostoma* and *acutus* and *Hypnale* for the other Asiatic species.

1977 Gloyd revived *Hypnale* (without mention to Burger's thesis or to Dissertation Abstract International 32 (10) 1972 but restricted to *Hypnale* only the species *H. hypnale*; *H. nepa* and a new species *H. walli*, giving a good diagnosis.

1978 Gloyd describes a new genus *Deinagkistrodon* for the single species *acutus*.

1981 Hoge and Romano Hoge conclude that *Agkistrodon* "sensu auctores" is a complex of five genera: *Agkistrodon* Beauvois, *Calloselasma* Cope, *Deinagkistrodon* Gloyd, *Hypnale* Fitzinger and a new genus *Gloydins*. They subdivide the subfamily *Crotalinae* in two tribe: *Crotalini* and *Agkistrodontini*.

TRIBE *Agkistrodontini*

Rattleless pit vipers with large symmetrical shields on top of the head; sometimes the internasals and prefrontals broken up into scales of scalelike shields. When broken up in scales dorsals in 17 row at midbody.

Contains five genera: *Agkistrodon* Beauvois, 1799; *Calloselasma* Cope 1859; *Deinagkistrodon* Gloyd 1978; *Gloydius* Hoge and Romano Hoge 1981 and *Hypnale* Fitzinger, 1843.

Range: Asia from the borders of Caspian Sea Eastwards to Japan and southwards to Sri-Lanka and Indonesia; North and Central America.

DIAGNOSIS OF THE GENERA

Agkistrodon Beauvois, 1799

A rattleless Pit Viper; nine large symmetrical shields on the upper surface of the head; internasals and praefrontals well developed; dorsals keeled; anterior subcaudals single; upper labials usually forming the anterior border of the loreal pit; snout not produced in a dermal appendage; skull short and broad; supratemporal (tabular) extending beyond the braincase. Skull very broad, as broad or nearly as broad as the distance of praefrontals from posterior and of braincase; palatine not deeply forked; ectopterygoid not hooked; broad and strongly curved,

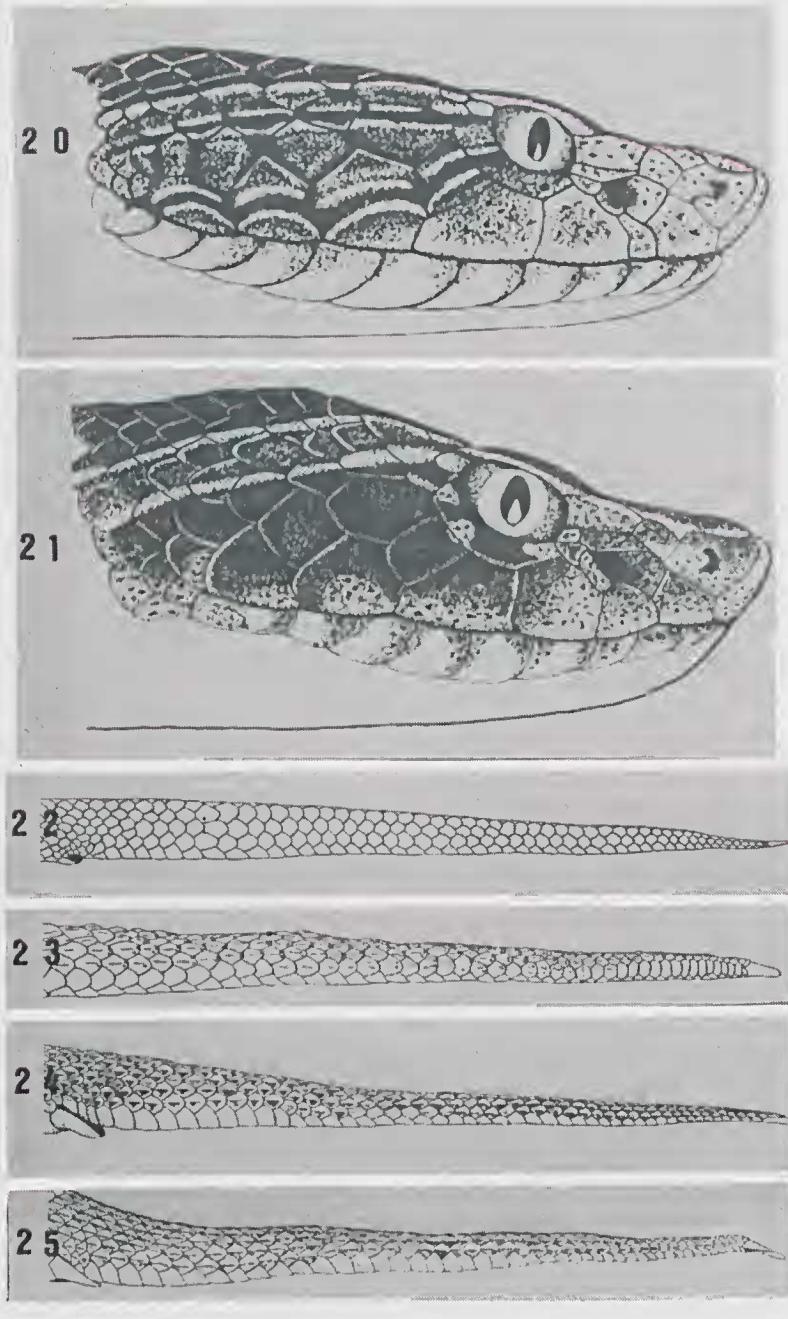


Fig. 20 — *Calloselasma rhodostoma*

Fig. 21 — *Calloselasma annamensis*

Fig. 22 — *Calloselasma rhodostoma*

Fig. 23 — *Deinagkistrodon acutus*

Fig. 24 — *Agkistrodon contortrix*

Fig. 25 — *Gloydius blomhoffii blomhoffii*

HOGUE, A. R. & ROMANO HOGUE, S. A. Notes on micro and ultrastructure of "Oberhäutschen" in Viperoidea. *Mem. Inst. Butantan*, 44/45:81-118, 1980/1981.



Fig. 26 — *Calloselasma rhodostoma*.
Courtesy of Knoll-Twiford Lab.
Photo Silberzahn und Meinberg.
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articulated with pterygoid on both internal and external side angular and splenial separated (fig. 77) (except for *A. bilineatus* fide Marx, 1972).

The structure of "Oberhäutschchen" shows allongated cell contours, (fig. 59).

Not related to any asiatic or european genera of *Agkistrodontini*, sharing only a single character with the monotypic genus *Deinagkistrodon*, in not having angular and splenial fused.

Contains: Three species, all viviparous.

Range: From North to Central America.

Calloselasma Cope 1860

A rattleless Pit Viper with; dorsal scales smooth loreal pit separated from the labials; subcaudals paired, palatine very peculiar with a long anterior process toothless or provided with a single teeth, ectopterygoid slender, hooked and not strongly curved; braincase broad, supratemporal not or nearly not extending beyond braincase; angular and splenial fused (fig. 82). Structure of oberhäutschchen nearly structureless not related with any of the other genera of *Agkistrodontini*.

Contains: Two species: *C. rhodostoma* and *C. annamensis*, oviparous.

Range: From Laos to Djawa.

Deinagkistrodon Gloyd, 1978

A rattleless Pit Viper related to both *Agkistrodon* and *Calloselasma*. Dorsal scales keeled; snout with a distinct dermal appendage; scales of the lowermost row near the tip of the tail distantly higher than wide, (upper head shields finely granulated; loreal pit bordered by the second upper labial; palatine with a dorsal process, deeply forked in front and provided by ±5 teeth ectopterygoid slender not hooked, even more strongly articulated with pterygoid than in *Agkistrodon*. Oberhäutschchen with rounded cells (fig. 61).

Angular and splenial not fused; (fig. 78)

Contains: a single species. Viviparous.

Range: South China, Tong-King, Taiwan.

Gloydius Hogue and Romano Hogue 1981

A rattleless pit viper different from, *Agkistrodon*, *Calloselasma* and *Deinagkistrodon* by cranium which is long and narrow scales of the lowermost row near the tip of the tail not distantly higher than wide, from *Calloselasma* by the keeled dorsals and not hooked ectopterygoid; from *Deinagkistrodon* by the absence of produced dermal appendage on snout; from both *Agkistrodon* and *Deinagkistrodon* by very short supratemporals not extending posteriorly beyond the braincase. Angular and splenial fused or not (Fig. 83). The M. O. different from all other *Agkistrodontini* but remembering both *Protobothrops* (*Crotalini*) and *Agkistrodon* (*Agkistrodontini*).

Contains: Seven species. Viviparous.

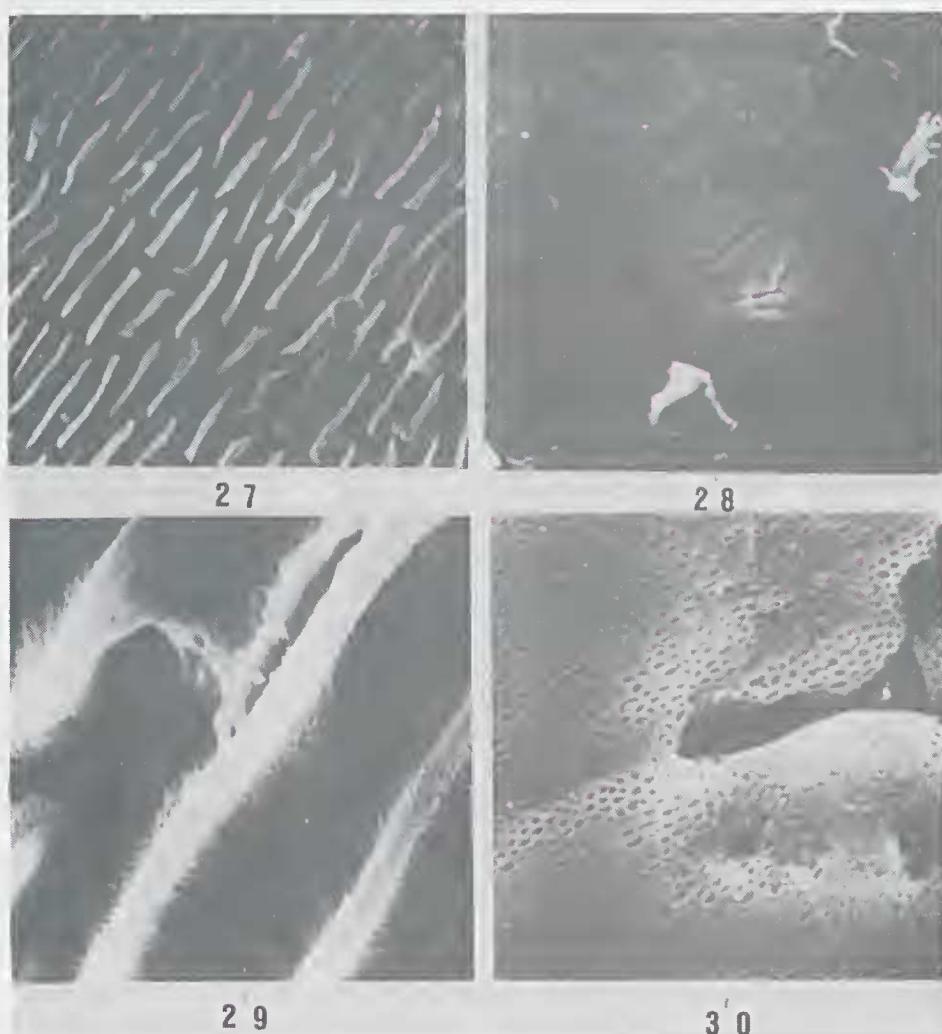


Fig. 27 — *Bothrops pradoi* (Scan. Micr. x 530)

Fig. 28 — *Trimercerus gramineus* (Scan. Micr. x 530)

Fig. 29 — *Bothrops pradoi* (Scan. Micr. x 4,500)

Fig. 30 — *Trimercerus gramineus* (Scan. Micr. x 4,500)

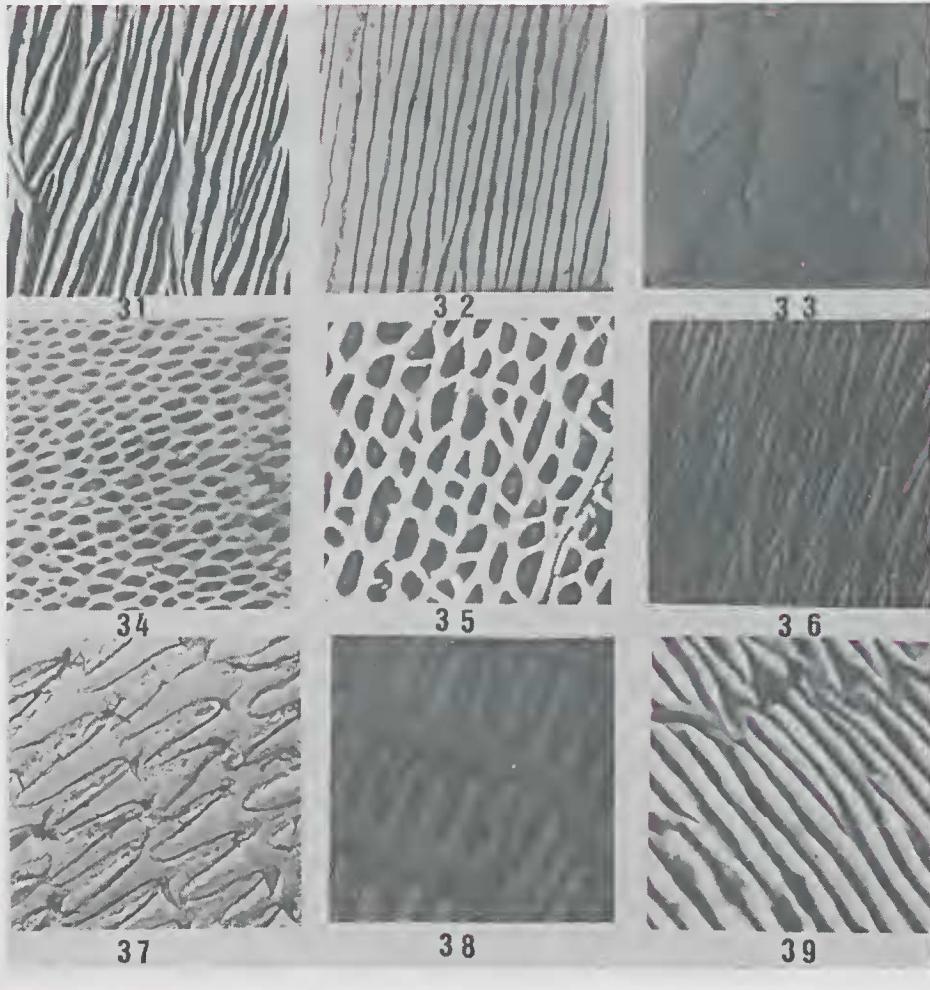


Fig. 31 — *Boa constrictor constrictor amarali* (Dorsal Electron Micr. x 6,200)

Fig. 32 — *Xenoboa cropanii* (Dorsal Electron Micr. x 6,200)

Fig. 33 — *Eunectes murinus* (Dorsal Electron Micr. x 6,200)

Fig. 34 — *Tropidophis paucidens* (Dorsal Electron Micr. x 6,200)

Fig. 35 — *Corallus caninus* (Dorsal Electron Micr. x 6,200)

Fig. 36 — *Lystrophis nattereri* (Dorsal Electron Micr. x 6,200)

Fig. 37 — *Conophis vittatus* — Type specimen — (Dorsal Electron Micr. x 7,200)

Fig. 38 — *Python reticulatus* (Dorsal Electron Micr. x 6,200)

Fig. 39 — *Crotalus durissus terrificus* (Dorsal Electron Micr. x 6,200)

Range: Eastern Europe; Continental Asia southwards to Indonesia and westwards to Japan.

Hypnale Fitzinger 1843

Distinct from, *Agiistrodon*, *Calloselasma*, *Deinagkistrodon* and *Gloydius* by the praefrontals and internasals which are broken up in scales by the dorsals which are in 17 rows; by the presence of a very short and strongly hooked ectoperygoid (only slightly hooked in *rhodostoma*) ; from *Agiistrodon* and *Gloydius* by the pattern of M.O., angular and splenial fused, (Fig. 84).

Contains: Three species. Viviparous.

Range: Sri-Lanka and India, Western Ghats as far north as 16.^o L.N.

ANNAMENIAN AND MALAYAN PIT VIPERS

During a stay at the "Laboratoire of Reptiles et Amphibiens" of the "Museum National d'Histoire Naturelle" in Paris, a very distinct pattern in some specimens of *Calloselasma* called our attention.

The fine collection of Reptiles and superior library of the Paris Museum; the large series of specimens in the British Museum and Rijksmus. Nat. Hist. at Leiden besides the previous notes on specimens in several other institutions, enabled us to conclud that two taxons are included under the name of *Agiistrodon rhodostoma*.

In march 1981 a visit to the Knoll-Twyford laboratories at Ludwigs-hafen allowed us, not only to observe the largest known series of live Malayan pit vipers, but also complete the data on geographical distribution. The Twyford laboratories maintain several hundreds of *Calloselasma rhodostoma* to produce the venom necessary for the elaboration of a commercial anticoagulant.

A drawing in Seba (1736) seems to be the first reference to a specimen of the actual genus *Calloselasma* but the poor quality of the fig. turns identification doubtfull, almost impossible.

The first good description of a specimen of *C. rhodostoma* belongs to Patrick Russel 1801-1809, pl. XXI:24-25. This description and drawing was based on a specimen from Java. No scientifical or vernacular name was given.

Reinwardt in Boie (1827) was the first to name the species as *Trigonocephalus rhodostoma*.

For about twenty years this species was consecutively included in the genera: *Vipera*; *Trigonocephalus* and *Tisiphone*.

Duméril (1853) created a separate genus for *rhodostoma*, *Leiolepis*, unfortunately preoccupied by *Leiolepis* Cuvier (Lizard).

Cope (1860) gives a subst. name, *Calloselasma* for *Leiolepis* Duméril 1853.

Boulenger (1896) puts *Calloselasma* in the synonymy of *Ancistrodon* in his Catalogue.

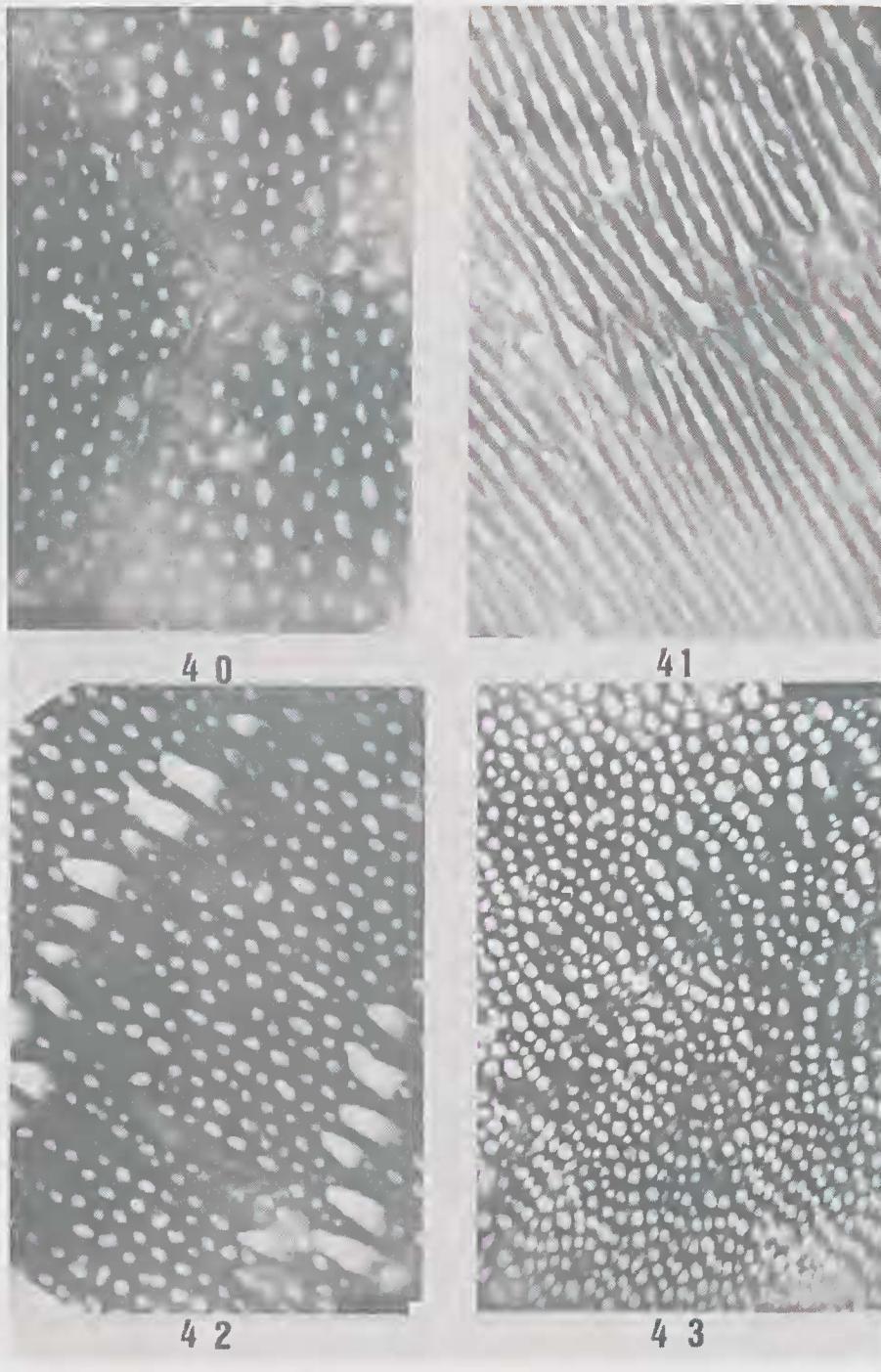


Fig. 40 — *Trimeresurus albolabris* (Dorsal Electron Micr. x 8000)

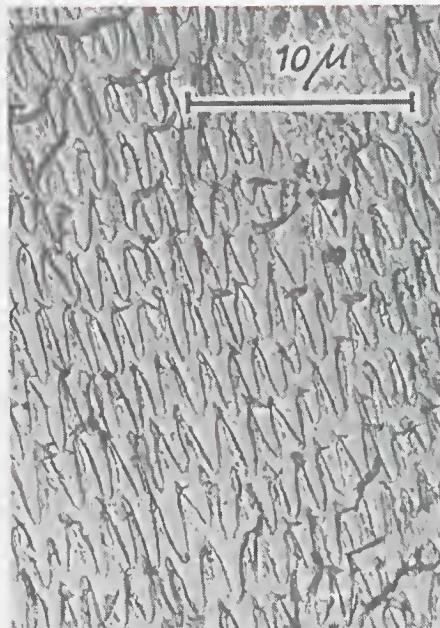
Fig. 41 — *Trimeresurus jerdoni* (Dorsal Electron Micr. x 8000)

Fig. 42 — *Bothrops jararacussu* (Paraventral Electron Micr. x 8000)

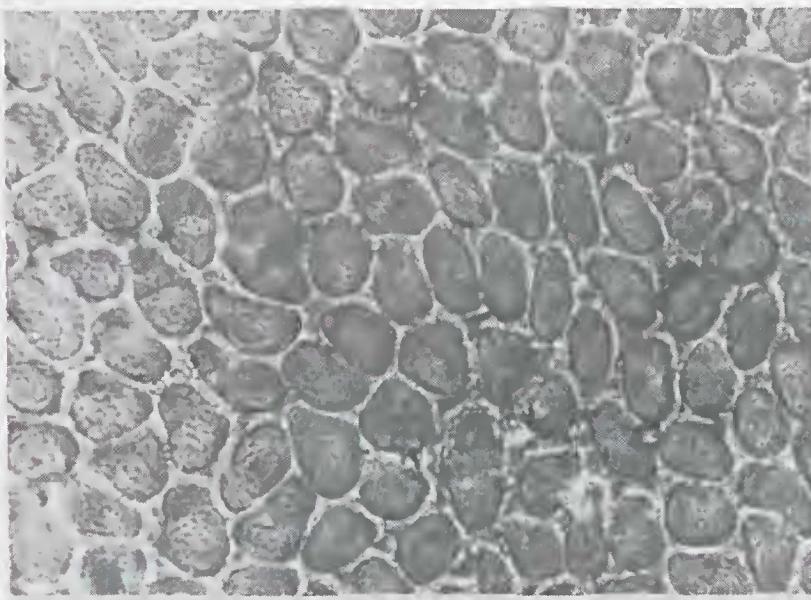
Fig. 43 — *Bothrops bicolor* (Paraventral Electron Micr. x 8000)



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Fig. 44 — *Ditaxodon taeniatus* — Type specimen (Dorsal Electron Micr. $\times 1,200$)

Fig. 45 — *Conophis vittatus* — Type specimen (Dorsal Electron Micr. $\times 1,200$)

Fig. 46 — *Porthidium lansbergii rozei* (Opt. Micr. $\pm \times 200$)

Angel (1933) describes a new species of *Agkistrodon* from Annam, *Agkistrodon annamensis*.

Smith (1943) puts *A. annamensis* in the synonymy of *A. rhodostoma*.

Klemmer (1963) mentions *A. annamensis* and *A. rhodostoma* without any comment.

Campden-Main (1970) uses *Calloselasma rhodostoma* for specimens from Vietnam.

Since Boulenger's Catalogue no attempt was made to revive *Calloselasma* except by Chernov (1957) who removed *Calloselasma* from the synonymy of *Agkistrodon* but was not followed by the authors, except Campden Main I.c.

Bürger 1971 in his dissertation for PhD thesis used *Calloselasma* for *rhodostoma* and *acutus*. In 1978 Gloyd formed a new genus for *acutus* (*Deinagkistrodon acutus*). In 1981 Hoge and Romano Hoge subdivided *Agkistrodon* "sensu auctores" in several genera: and includes them in a new tribe the *Agkistrodontini*:

Agkistrodon Beauvois 1799 for the American species (3 species)

Calloselasma Cope, 1860 (two species)

Deinagkistrodon Gloyd 1978 (one species)

Gloydius Hoge and Romano-Hoge 1981 nom subst. pro *Halys* Gray 1849 preoccupied by *Halys* Fabricius 1803 (seven species).

Hypnale Fitzinger 1843 (three species)

Calloselasma annamensis (Angel)

Annamenian Pit Viper (Fig. 6, 8, 12, 13 and 14)

1875 *Calloselasma rhodostoma*; Morice, Coup d'oeil sur la faune Coch. Franç. Rept., :67.

1885 *Calloselasma rhodostoma*; Tirant (partim ?), Excurs. et Reconnaissance 20:399 (not seen) fide Saint Girons.

1885 *Calloselasma rhodostoma*; Tirant (partim ?), Notes sur les Reptiles et Batraciens de la Conchinchine et du Cambodge, Saigon:37

1933 *Ancistrodon annamensis* Angel, Bull. Mus. Nat. Hist. Nat., Paris, Serie 2 (2), 5:277, fig. 1.

1936 *Agkistrodon annamensis*; Bourret, Serp. Indo-Chine, :454.

1943 *Ancistrodon rhodostoma*; Smith (partim) The Fauna of British India, Ceylon and Burma including the whole of the Indo-Chinese Sub-Region vol. III — Serpentes:497 text fig. 158 A, B and C.

1963 *Agkistrodon annamensis*; Klemmer, Behringwerk-Mitteil. Die Giftschlangen der Erde. (Sonderband) :397.

1968 *Agkistrodon rhodostoma*; Leviton (partim), Venomous Vertebrates. Acad. Press., 1, p. 560.

1970 *Calloselasma rhodostoma*; Campden-Main (partim), A Field guide to the Snakes of South Vietnam, USNM:96 + text, fig. + maps.



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Fig. 47 — *Atheris nitschei nitschei*

Fig. 48 — *Echis carinatus pyramidum*

Fig. 49 — *Vipera lebetina turanica*

Fig. 50 — *Vipera russelli russelli*

All fig. Opt. Micr. ± x 100



5 1



5 2



5 3



5 4

Fig. 51 — *Bothrops moojeni*

Fig. 52 — *Trimeresurus gramineus*

Fig. 53 — *Tropidolaemus wagleri*

Fig. 54 — *Atractaspis irregularis conradsi*

All fig. Opt. Micr. $\pm \times 100$

1972 *Agirostrodon rhodostoma*; Saint Gérons (*partim*), Mem. Mus. Nat. Hist. Nat. Série A Zoologie, 74:153.

1981 *Calloselasma annamensis*; Hoge and Romano-Hogé, Mem. Inst. Butantan, 42/43:193, 1978/79 (1981).

Type locality: Vinh-Hoa, Southern Annam Vietnam.

Range: Eastern Cambodge, Southern Annam, Vietnam (map. fig.)

MATERIAL

M.N.H.N.P.N^r. 1933-23, ♀ (Type specimen) from "Sud de l'Annam", Vietnam, col. by the "Mission Citroën"; M.N.H.N.P.N^r. 1887-173, from Tonkin, don. by Heckel; M.N.H.N.P.N^r. 1920-215, ♀ and 1920 A-215 juv. from Cap Saint Jacques, Sud Vietnam, col. by Mignon; M.N.H.N.P.N^r. 1911-67, ♂ and 1911-67, ♀ from Cap Saint Jacques, Sud Vietnam, col. by Chatel; M.N.H.N.P.N^r. 1912-76, ♂ and 1912-79, ♀, from Cambodge col. by Charpentier, M.N.H.N.P.N^r. 1937-30, ♀. Environ de Bien-Hoa Sud Vietnam, col. by Toilane; M.N.H.N.P.N^r. 1970-582 Plantation Krek, Cambodge, col. by Saint Giron; B.M.N^r. 1937-2-1-17, ♀ (bad state of preservation) Nakham between (Uteradit and Paklay N.E. Siam press. by M. A. Smith; B.M.N^r. 1937-2-1-13, O, from N.W. of Raheng Northern Siam; B.M.N^r. 1921-4-1-49, O and 1921-4-1-50, O from Cap Saint Jacques South Vietnam pres. by M. A. Smith; B.M.N^r. (7505), 1968-837, O Chamb-Am P. Siam foot of Hill., M. A. Smith pres. B.M.N^r. (8268) 1968-839 O N.W. of Raheng (Rak ng?) (Now Tsheng (=Tak) Thailand, col by Nai Put; B.M.N^r. (2610) 1968-841, O, from Cap Saint Jacques. For the elaboration of the maps following localities where quoted (They were tentatively attributed to *annamensis* on base of geographical localisation): Sakhon Nakon, Prov. Sakon Nakhon, Thailand; Lop Buri, Prov. Lop Buri, Thailand; Korat (=Nakon Ratchasima) prov. of Nakhon Ratchasima Thailand.

Kumpawapi 250 km North of Korat = Nakon Ratschásima) Thailand Lat. 17° 10'N long. 102° 50'E.

Nong Kai; Chiang Mai; Thailand. Laos and the following localities in Vietnam; Phu Rieng, Pham Rang, Loe Ninh, Ben Cat. Xaun Loc, Long Binh, Phu Vinh and Kompong Speu.

DESCRIPTION

Closely related to *Calloselasma rhodostoma* but postocular band indistinct and never festooned (fig. 3, 4, 8 and 21).

Calloselasma rhodostoma Reinwardt in Boie

Malayan Pit Viper

1736 in Seba, Thes. 2, pl. 68, fig. 6 (?). Very bad drawing and identification doubtfull.

1801-1809 in Russel, Cont. acc. Indian Serpents., 2, pl. 21:24.

*1827 *Trigonocephalus rhodostoma* Reinwardt in Boie, Isis 1827, 22:561.

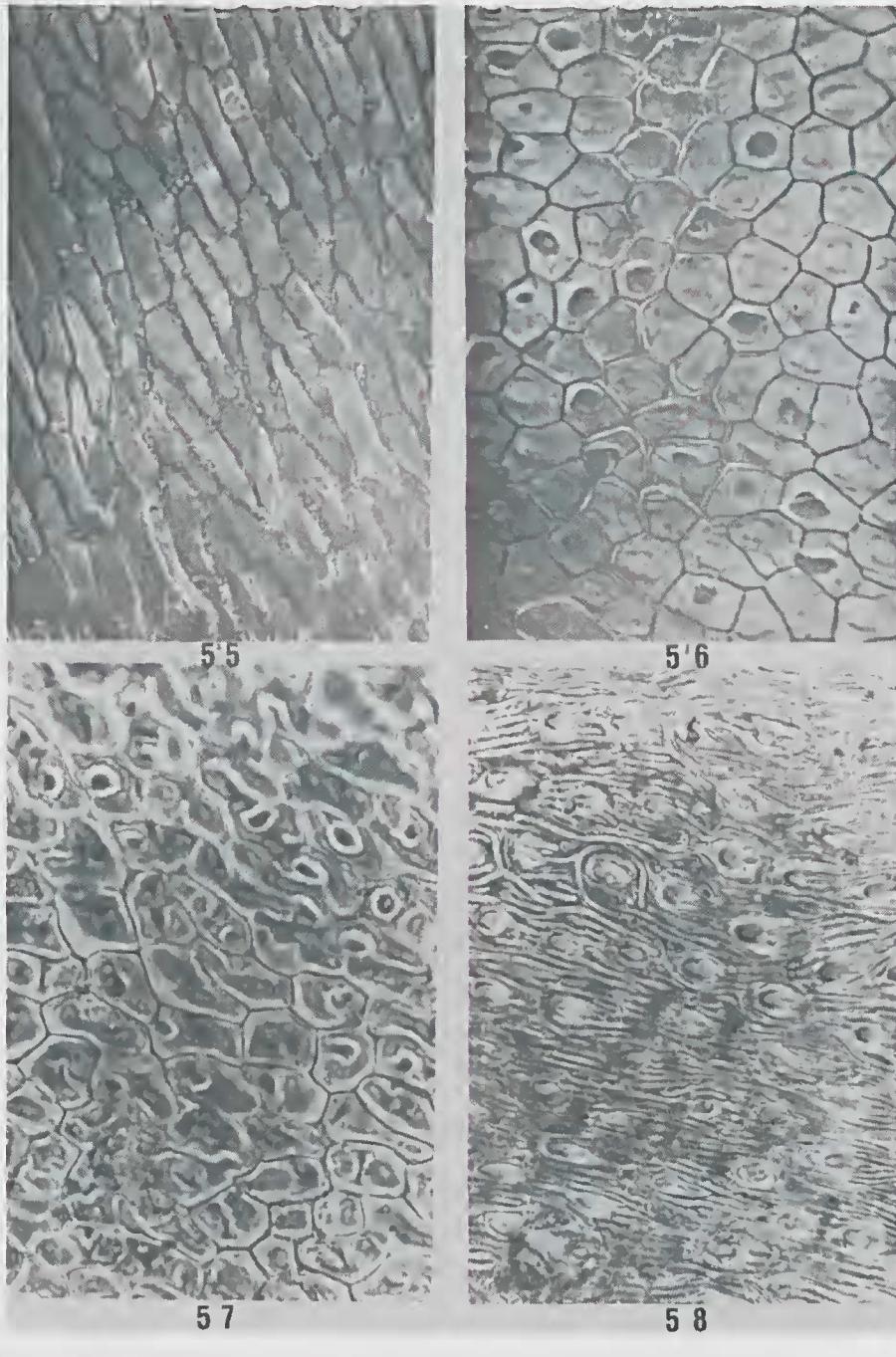


Fig. 55 — *Bothrops moojeni*

Fig. 56 — *Trimeresurus albolabris*

Fig. 57 — *Bothriechis nigroviridis marchi*

Fig. 58 — *Tropidolaemus wagleri*

All fig. Opt. Micr. $\pm \times 200$

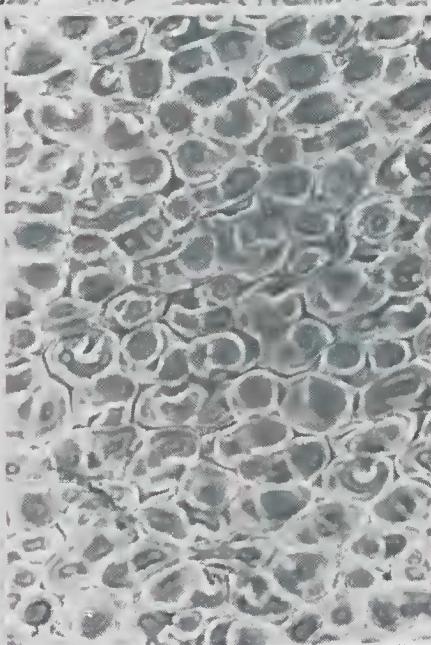
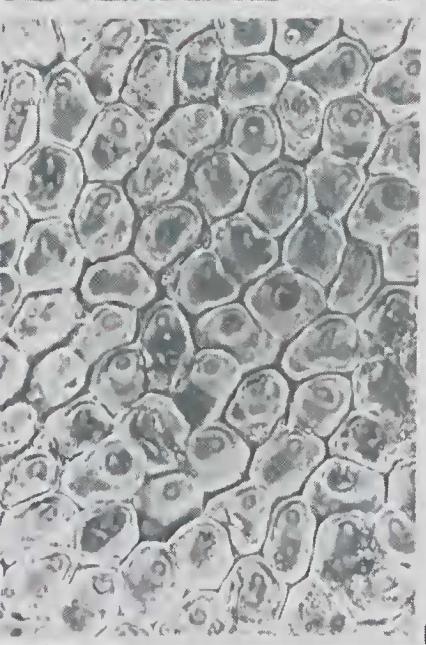


Fig. 59 — *Agkistrodon bilineatus*

Fig. 60 — *Hypnale hypnale*

Fig. 61 — *Deinagkistrodon acutus*

Fig. 62 — *Ovophis okinavensis*

All fig. Opt. Micr. $\pm \times 200$

1830 *Trigonocephalus rhodostoma*; Wagler. Syst. Amph.:174.

1832 *Vipera praetexta* Gravenhorst. Deliciae Mus. Vratisv. *Trigonocephalus praetexta* Hemprich.

1837 *Trigonocephalus rhodostoma*; Schlegel, Essai Phys. Serp. 1:190, 240 and 2:547, pl. 20, fig. 1-3.

1843 *Tisiphone rhodostoma*; Fitzinger. Syst. Rep.: 28.

1844 *Trigonocephalus rhodostoma*; Schlegel. Abb. n. Amph. 59-63, 140, pl. 19, fig. 1-10 and pl. 49.

1849 *Trigonocephalus rhodostoma*; Gray, Cat.: 19.

1853 *L[eiolepis] rhodostoma*; Duméril, Mém. Acad. Sc., 23:534.

1854 *Leiolepis rhodostoma*; Duméril, Bibron et Duméril, Erp Gén. 7(2):1500.

1859 (1858-1859) *T[rigonocephalus] (Tisiphone, Fitz.)*, *rhodostoma*; Jan, Prodome d'une Iconographie descriptive des ophiidiens...:29.

1860 *Calloselasma [rhodostoma]*; Cope, Proc. Acad. Sci. Philadelphia (1859):336.
(1861 fide Troschel).

1861 (1860) *Trigonocephalus rhodostoma*; Reinhardt, Herpetologiske Meddelelser.

1863 (*Tisiphone*) *T[rigonocephalus] rhodostoma*; Jan Elenco sist.:125.

1863 *Tisiphone rhodostoma*; Peters. Mb. Berl. Akad., 1862:673.

1864 *Calloselasma rhodostoma*; Günther, Rept. Brit. India:391.

1870 (1869) *L[eiolepis] rhodostoma*; Westphal-Castelnau, Cat. col. Rept.:|49|.

1872 *Trigonocephalus rhodostoma*, Schlegel, De dierenterin:43 + fig.

1874 *Trigonocephalus rhodostoma*; Jan, Icon. Gén. Ophid livr. 46, pl. 6, fig. 2.

1892 *Ancistrodon rhodostoma*; Boettger, Ber. Off. Verh. Nat., 29/32:135. (non vidi)

1896 *Ancistrodon rhodostoma*; Boulenger, Cat. Snake Brit. Mus., 3:527.

1902 *Ancistrodon rhodostoma*; Lampe et Lindholm. Jahrb. d. Nass. Ver. f. Nat. 55:43.

1912 *Agkistrodon rhodostoma*; Barbour, Mém. Mus. Comp. Zool. Harvard Coll., 44:139.

1912 *Ancistrodon rhodostoma*; Boulenger. Vert. Fauna Malay Peninsula, Rept. and Batrachia, :213, fig. 64.

1904 *Ancistrodon rhodostoma*; Annandale, J. Asiat. Soc. Bengal., 73:207-212.

1914 *Ancistrodon rhodostoma*; Smith, J. Nat. Hist. Soc. Siam., 1:57-58.

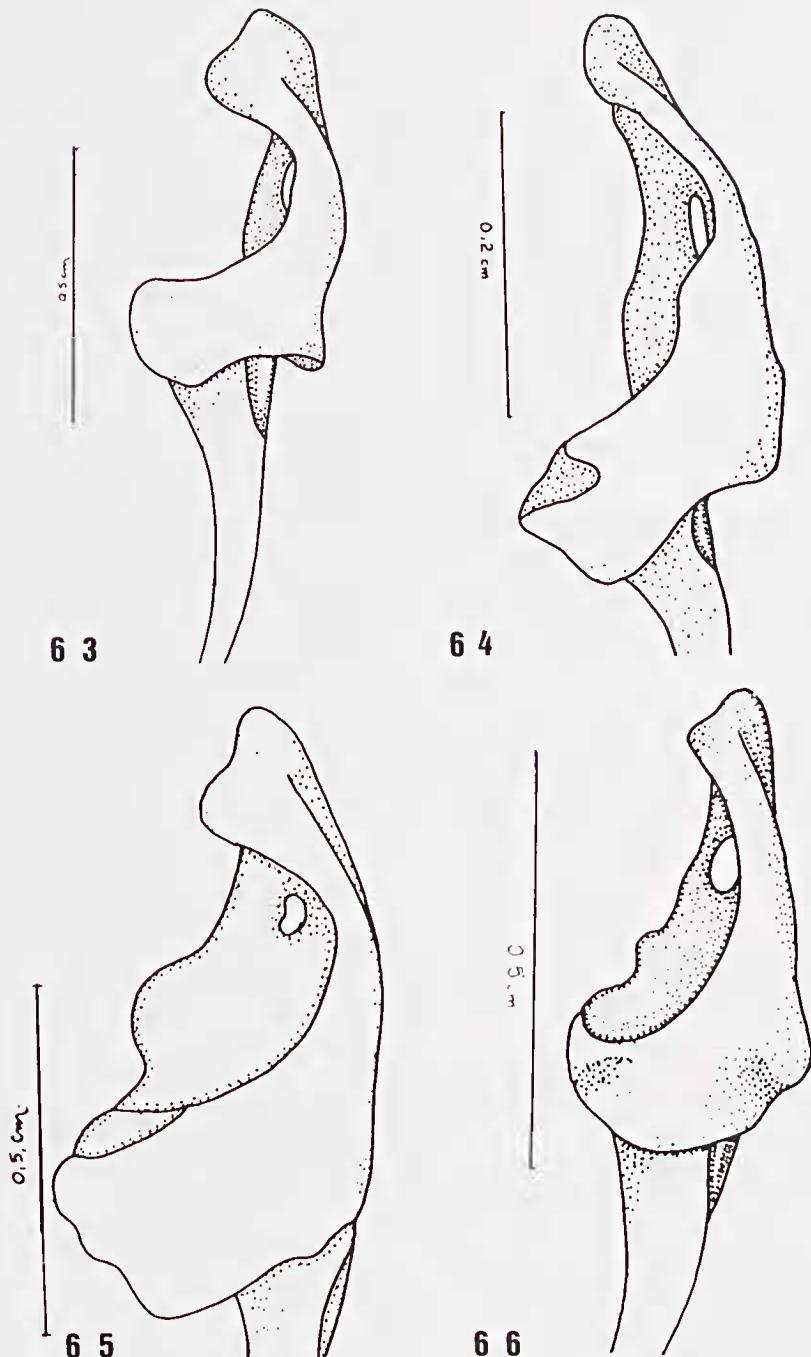


Fig. 63 — Maxillary of *Bothrops lanceolatus*

Fig. 64 — Maxillary of *Trimercerus gramineus*

Fig. 65 — Maxillary of *Ophophis chaseni*

Fig. 66 — Maxillary of *Porthidium lansbergi*

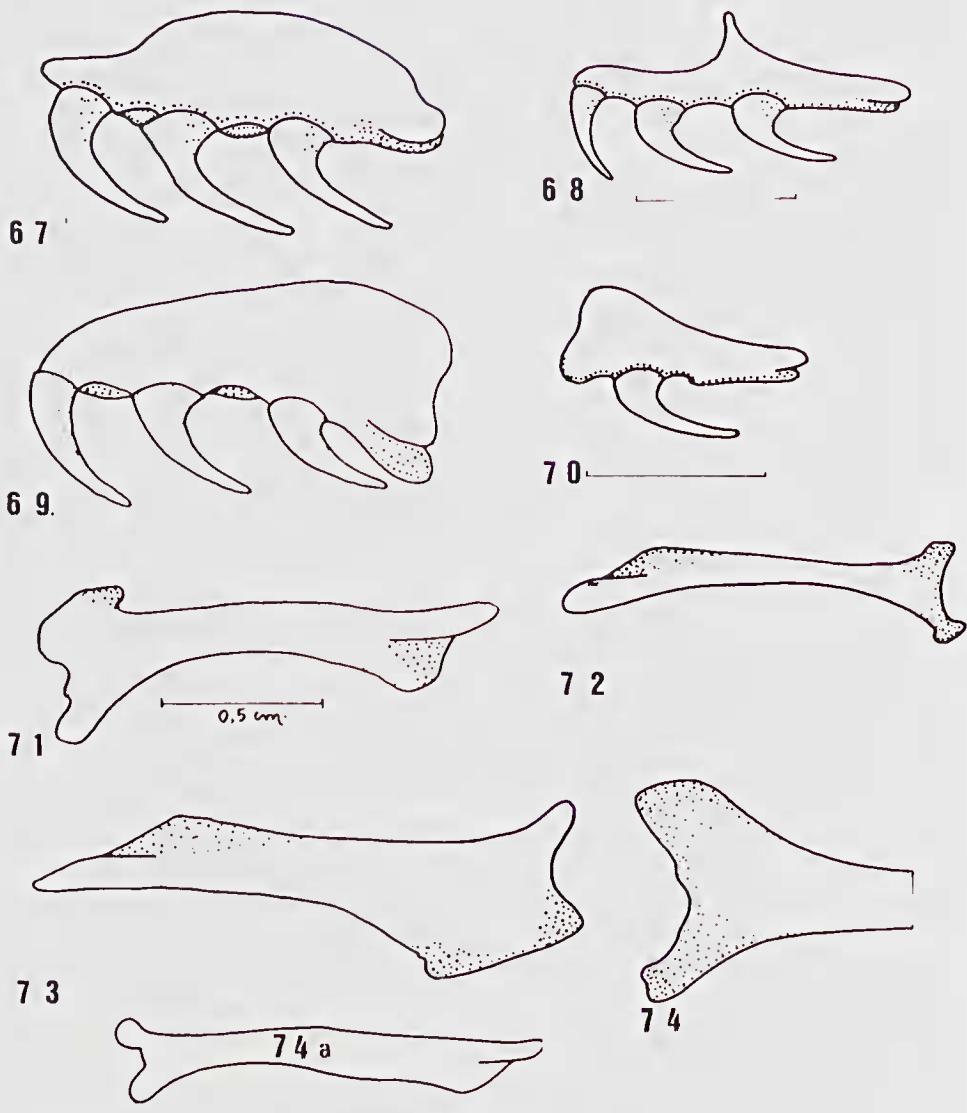


Fig. 67 — Palatine of *Trimersurus gramineus*

Fig. 68 — Palatine of *Bothrops lanceolatus*

Fig. 69 — Palatine of *Ovophis chaseni*

Fig. 70 — Palatine of *Porthidium lansbergi*

Fig. 71 — Ectopterygoid of *Ovophis chaseni*

Fig. 72 — Ectopterygoid of *Porthidium lansbergi*

Fig. 73 — Ectopterygoid of *Trimersurus gramineus*

Fig. 74 — Ectopterygoid of *Bothrops lanceolatus*

1915 *Ancistrodon rhodostoma*; Smith, J. *Bombay Nat. Hist. Soc.*, 23:787-788+Photo.

1916 *Ancistrodon rhodostoma*; Smith, J. *Nat. Hist. Soc. Siam.*, 2:164.

1916 *Ancistrodon rhodostoma*; Ouwens. *De Voorn. Giftsl. Nederl. Cost Indie*, 19, pl. 13.

1916 *Ancistrodon rhodostoma*; Gyldenstolpe, Handl. *Sven. Akad. Stockholm*, 4(3):27, Mus. Singapure.

1917 *Ancistrodon rhodostoma*; de Rooij Rept. Ind. Austr. Archip., 2, *Ophidia* 279, figs. 114-115.

1930 *Agkistrodon rhodostoma*; Smith, *Bull. Raffles*, 3:[89].

1930 *Agkistrodon rhodostoma*; Cochran, *Proc. U.S.N. Mus.*, 77:37.

1934 *Agkistrodon rhodostoma*; Brongersma, *Zool. Med. Rijksmuseum Nat. Hist. Leiden*, 17:161-251.

1934 *Agkistrodon rhodostoma*; Mertens, *Arch. f. Hydrobiologie (Supl.)* 12:Trop. *Binnengew.*, 4:677-701.

1936 *Agkistrodon rhodostoma*; Bourret, *Serp. de L'Indo-Chine*:45.

1953 *A [gkistrodon] rhodostoma*; Cochran, *Smiths. Inst. war back. stud. n.^o (10)*:21.

1943 *Ancistrodon rhodostoma* Smith (*partim*), *Fauna India, Rept. and Amph.*, 3:497.

1944 *Agkistrodon rhodostoma*; Cochran. From the Smithsonian report for 1943 (public. 3753) :275-324 + 23 pl. Washington D.C. Un. Stat. Gov. printing offices.

1945 *A [gkistrodon] rhodostoma*; Loveridge. *Rept. o.t. pacific world*:178-180.

1950 *Agkistrodon rhodostoma*; Haas, *Treubia*, 20:608.

1954 *Ancistrodon rhodostoma*; Tweedie. *The Snakes of Malaya, Singapore*, :114.

1957 *Calloselasma rhodostoma*; Chernov. *Zool. J.*, 36(5):792.

1958-1958 *Agkistrodon rhodostoma*; Taylor et Ebbel, *Univ. Kansas, Sci. Bull.*, 38,(2) n.^o 13:1168.

1959 *Agkistrodon rhodostoma*; Hoesel, *Ophidia Javanica*, 1:1-88, figs. 122-123.

1959 *Agkistrodon rhodostoma*; Mertens, *Treubia.*, 25,(1).

1961 *Agkistrodon rhodostoma*; Deuve *Bull. Soc. Sci. Nat. Laos* n.^o 1:30.

1962 *Agkistrodon rhodostoma*; Deuve, *Bull. Soc. Sci. Nat. Laos* (2):81.

1962 *Agkistrodon rhodostoma*; Deuve, *Bull. Soc. Sci. Nat. Laos* (2):88.

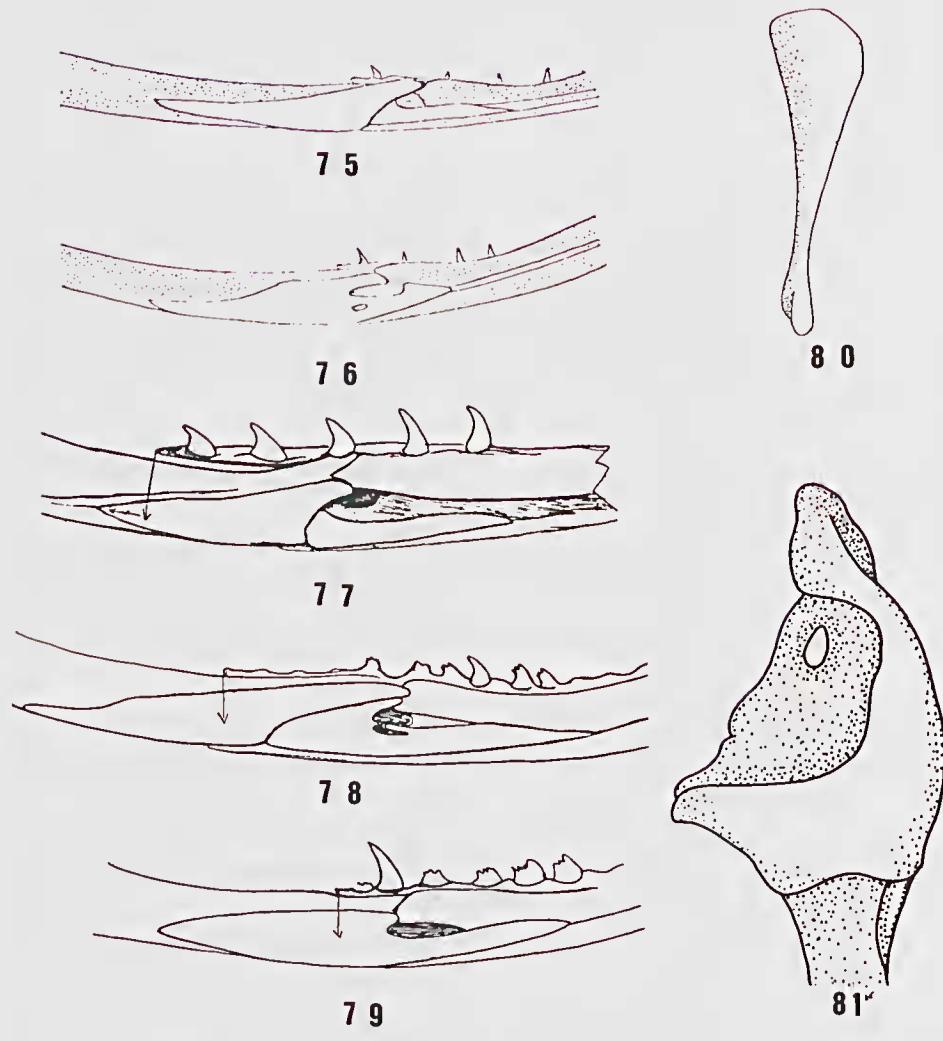


Fig. 75 — *Bothrops atrox*
Fig. 76 — *Porthidium lansbergi*
Fig. 77 — *Agiistrodon piscivorus*
Fig. 78 — *Deinagkistrodon acutus*
Fig. 79 — *Gloydius blomhoffii*
Fig. 80 — *Protobothrops flavoviridis*
Fig. 81 — *Protobothrops jerdoni*

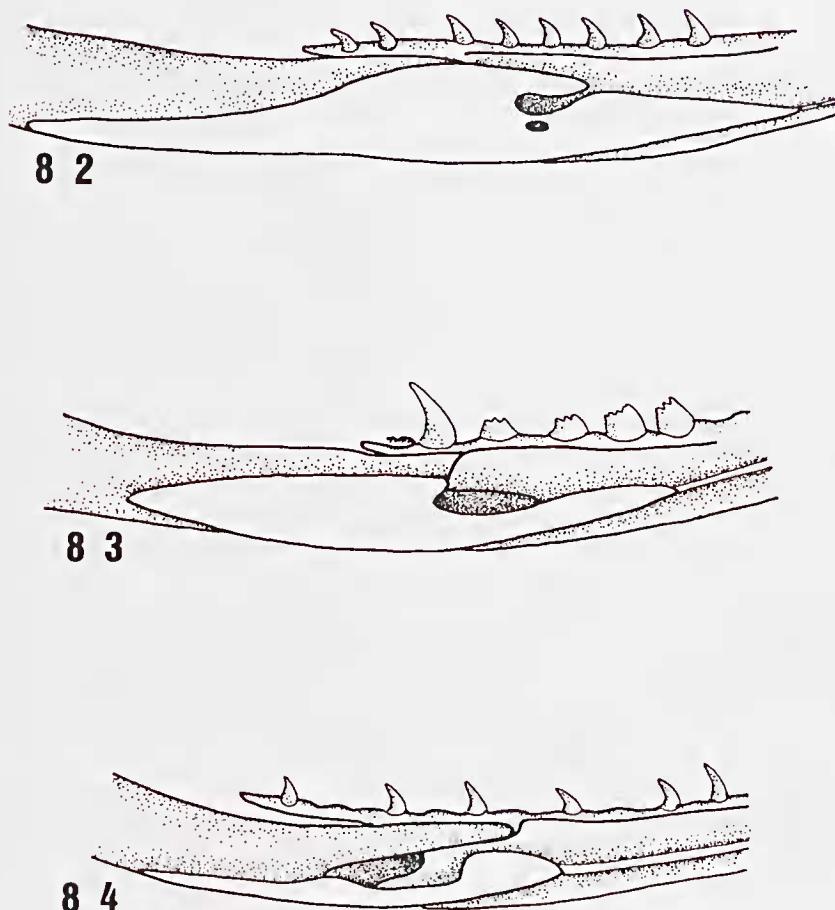


Fig. 82 — *Callosclasma rhodostoma*

Fig. 83 — *Gloydius blomhoffii*

Fig. 84 — *Hypnale hypnale*

1962 *Agkistrodon rhodostoma*; Deuve, Bull. Soc. Sci. Nat. Laos (2) :77, 78, 79, 81.
1962 *Agkistrodon rhodostoma*; Deuve, Bull. Soc. Sci. Nat. Laos (3) :20.
1962 *Agkistrodon rhodostoma*; (partim), Depart. Navy ONI Study 3-62:126.
1963 *Agkistrodon rhodostoma*; Klemmer, Behringwerke Mitt. Sonderb. :401.
1965 *Agkistrodon rhodostoma*; Taylor, (partim), Univ. Kansas Sci. Bull., 45, (9) :1058, fig. 120.
1968 *Agkistrodon rhodostoma*; Leviton, (partim), Ven. Vertebrates. Acad. Press., 1:560.
1971 *Calloselasma rhodostoma*; Burger (partim), Genera of Pit Vipers. PhD. diss. Publ. microf. Ann. Arbor:100, fig. 4b.
1972 *Agkistrodon rhodostoma*; Saint Girons (partim), Mem. Mus. Nat Hist. Nat. Série A — Zoologie 74:153, pl. 41 + map.
1978 *Calloselasma rhodostoma*; Gloyd (partim), Proc. Biol. Soc. Washington, 963.
1981 *Calloselasma rhodostoma*; Hoge and Romano-Hoge, Mem. Inst. Butantan, 42/43:193, 1978/79 (1981).

TYPE LOCALITY: Djawa.

RANGE: Malaysia south of Isthmus of Kra and Djawa: a few specimens known from Thailand and Cambodge, Saint Girons collected both *C. rhodostoma* and *C. annamensis* at Kreck, Cambodge.

The species seems to be absent in Sumatra (a specimen in the collection of the RMNHL Nr.11454 leg. Dubois is labelled Sumatra without any other data; two more specimens, leg. P.G.Niel.Nr.20392 and 20393 also are labelled Sumatra). In 1896 Boulenger in his Catalogue noticed only specimens from Java and a single one as being from Siam with? (actually BMNr.62.11.1.243). The first specimens without doubt from Siam are those collected by Annandale and Robinson in Perak and the Siamese Malay States and identified by Boulenger who prepared list of Malayan reptiles. He confirms the occurrence of *A. rhodostoma* in Siam whence a specimen has been received by the Christiana Museum and also records the species for Biserat. A parallel case of discontinuous distribution is afforded by *Geoclemys subtrijuga* and several other species, as already stated by Boulenger and Barbour 1.c.

All the specimens seen by Boulenger are still in the herpetological collection of the British Museum belong to the species *C. rhodostoma* and not a single one to the species *C. annamensis*.

MATERIAL:

M.N.H.N.P.Nr.411 a ♀ and 411A, a ♂, from Batavia, col. D'Istria; M.N.H.N.P.Nr.576 (2 spec.) from Java, col. Quoy and Gaimard; M.N.H.



N.P.Nr.7761 from Java, col. Leschenault; M.N.H.N.P.Nr.4045 and 4046, from Java, col. Bleeker; M.N.H.N.P.Nr.1893-124, ♂, from "Prov. de Bangtaban" Malayan peninsula, col. Bel; B.M.Nr.(1834-MAS) 1968-838, head only; B.M.Nr.(6322) 1968-840 from KHAORAM (food of Hill); B.M.Nr.(1835-MAS); 1968-843 Hupbon B.M.Nr.(7165) 1968-842 from Nong SE Siam; B.M.Nr.(1833) 1939 a ♂ from Bangnara; B.M.Nr.1885, 12.31.31 a ♂ from Wellus Mountains Kediri, Java 5000 ft.; by Baron v.Hnegal; B.M.Nr.62.11.1. 243 a ♀ from Siam; B.M.Nr.1879.16.2 a 13 and 1879.16.20.14 from Java pres. A. Scott; B.M.Nr.66.8.14.316 a ♀ from Java; B.M.Nr.1903.4.13.98, ♀, and 1903.4.13.100 from Jahor Malayan peninsula; B.M.Nr.1891.5.1.16 a, ♀, and 1891.5.1.17 ♂, from Batavia; B.M.Nr.44.2.22.47, ♀ pres. Leyden Mus.; B.M.Nr.1915.5.13.13, ♂, from Bantaphan Siam col. Malcon Smith; B.M.Nr.1969 from Sve Umbel col. Malcom Smith 1918 R.M.N.H.L.Nr.318 (3 spec.) from Java? leg. Boie and Macklat; R.M.N.H.L.Nr.1509 from Java, leg. S. Muller; R.M.N.H.L.Nr.1510 from Java leg. C.G.C. Reinwardt R.M.N.H. from Buitemorg leg van Slooten; R.M.N.H.Nr.5808 from Babakan Djatti, Res. Krawang Java leg. W.V. van Heurn; R.M.N.H.L.Nr.7433 (2 spec.) from Botanical Garden, leg Kannegieter; R.M.N.H.L.Nr.7474 (4 spec.) from Radjamala, W. Java, leg J. Semmelink. R.M.N.H.L.Nr.7490 (2 spec.) from Buitenzorg Java leg. Buitendijk R.M.N.H.L.Nr.8013 (1 spec.) from Buitenzorg, Java. R.M.N.H.L.Nr.8969 (2 spec.) from Indramajoe, W. Java, leg. F. Kopstein (not seen!); R.M.N.H.L.Nr.9736 (2 spec) from Depak near Batavia Nature Reserve (now Depok near Jakarta Djawa); R.M.N.H.L.Nr.10134 (2 spec.) from Java leg. Tegelaar; R.M.N.H.L.Nr.10319 (2 spec.); from Malong Java; R.M.N.H.L.Nr.11454, from Sumatra, (now Sumatera), leg. Dubois; R.M.N.H.L.Nr.20381 from Surroundings of Buitenzorg, leg P. Buitendijk; R.M.N.H.L.Nr.20382 from Buitenzorg leg P. Buitendijk; R.M.N.H.L.Nr.20383 and 20384 from Buitenzorg leg F. Verbeek; R.M.N.H.L.Nr.20385 from Dessa Sambengwangon, Rembang Java leg Fr. Verbeek; R.M.N.H.L.Nr.20386 (6 spec.) from Radjaman-dala, Bandoeng, W. Java leg F. Kapstein; R.M.N.H.L.Nr.20391 (no data); R.M.N.H.L.Nr.20392 and 20393 from Sumatra leg P.G. Neeb; R.M.N.H.L.Nr.20394 from Java; R.M.N.H.L.Nr. 20395 from Buitenzorg; R.M.N.H.L.Nr.20396 from Bandoeng, W. Java leg E. Jacobson; 20397 and 20398 from Tandji near Semarang Java leg P. Buitendijk. I.B.H.Nr.31 Java (gift from Königl. Natur. Sammlung in Stuttgart, (1912); I.B.H.Nr.19216 Java, gift from I.R.S.N. Belgique; I.B.H.Nr.19227; Java I.R.S.N. Belgique; I.B.H.Nr. 4234 from Buitenzorg, Java leg T. Barbour. In lit. Barbour (1912) Buitenzorg. Gunung Bundes on Mt. Salak 2200 ft am Daru in Bantam.

DESCRIPTION

Snout pointed, somewhat turned up; rostral as high as broad or slightly higher, internasals a little longer than broad, shorter than the prefrontals; frontal as long, or longer than its distance to the tip of the snout, longer than broad, as long or a little longer than the parietals; parietals slightly longer than broad; 3 preoculars; a loreal between the upper preocular and posterior nasal; a large subocular separating the eye from the upper labials; loreal pit not in contact with upper labials;

1 or 2 postoculars; 7 to 9 upper labials; all cephalic shields and scales smooth; dorsals in (23-25) — (21-17) longitudinal rows all smooth 138-157 ventrals in males, 157-166 in females; 34-46 pairs of subcaudals in females and 45-55 in males.

Reddish brown with a series of dark brown, black edged spots opposite to one another or alternating; generally a black vertebral line, interrupted or not; the spaces between the dorsolateral spots are distinctly lighter in color, sometimes ill defined darker marking in the light interpaces. Belly white to yellowish, powdered or not with dark brown on the borders of ventrals and two outer dorsals series of dark, sometimes indistinct roundish dots. A broad dark brown band from the eye to the angle of mouth. Black edged, always festooned below (fig. 20). Sometimes upper and lower black edges rimmed with light yellow.

The juveniles have brighter colors than the adults (fig. 26); vivacious yellow tails. When aging, small dark spots appear on the dorsal surface; the spots spread gradually sideways leaving the yellow color undefined in the adult.

Total length 1030 mm.

This species is mainly found in heavily forested areas.

ARTIFICIAL KEY TO THE *Aghistrodonini* *

I. Dorsal scales smooth (fig. 22) *Calloselasma*

II. Dorsal scales keeled.

A — Praefrontals and internasals broken up in scales (fig. 18); dorsal scales in 17 rows; snout turned up (fig. 16)... *Hypinale*.

B — Praefrontals and internasals not broken up in scales; dorsals not in 17 rows.

1. Snout with a distinct dermal appendage (fig. 17); scales of the lowermost row near the tip of tail much higher than long (fig. 23) *Deinagkistrodon*
2. Snout and scales near the tip of tail not as above; (fig. 24 and 25).
 - a) All subcaudals paired; loreal pit always separated from labials *Gloydius*
 - b) Anterior subcaudals single; loreal pit generally bordered by a labial *Aghistrodon*

KEY TO THE SPECIES OF *Calloselasma*

1. The postocular dark band very distinct, black edged and always festooned (fig. 9 and 20) *rhodostoma*
2. The postocular dark band indistinct not festooned below (fig. 8 and 21) *annamensis*

* In case of doubt on any characters check skull, if:

1. Short and broad; supratemporal extending beyond the brain case = *Aghistrodon*.
2. Long and narrow; supratemporal not extending beyond the brain case = *Gloydius*.

ACKNOWLEDGMENTS

Our thanks go to several institutions and persons for loans or permission to study the specimens namely: (C. Myers; R. G. Zweifel) American Museum of Natural History; (G.R. Zug) Smithsonian Institution; (Alice Grandisson) British Museum Natural History; To Knoll-Twyford Laboratories at Ludwigshafen, Germany for the permission to examine the alive specimens. To Miss Alma Yasodhara Alexandra Hoje for technical aid helping the examination of the Knoll-Twyford and M.N.H.N. Paris specimens and redaction of manuscript. To João Domingues Cavalheiro for redrawing the figs. 20-25. Our special thanks to Dr. E.R. Brygoo for his invitation and Mrs. Brygoo for the photographs of specimens (Museum National d'Histoire Naturelle, Paris) and to Dr. M.S. Hoogmoed Rijksmuseum van Natuurlijke Historie, Leiden, who kindly checked the shape and form of postocular band in all available specimens in the Rijksmuseum van Natuurlijke Historie, Leyden. We are also indebted to the: Application laboratory, Naka works of the Hitachi, Ltd of Tokyo, Japan for photographs with scanning microscope.

RESUMO: Descrição de uma técnica nova para o estudo microscópico da "oberhäutschen"; descrição de um gênero novo: *Protobothrops*; os gêneros, *Porthidium*, *Bothriechis* e *Bothriopsis* são considerados distintos de *Bothrops*; uma diagnose sumário dos *Agkistrodontini* e redescruição de *Calloselasma rhodostoma* e *Calloselasma annamensis*.

PALAVRAS-CHAVE: "Oberhäutschen"; Viperoidea; *Protobothrops*; *Porthidium*; *Bothriechis*; *Bothriopsis*; *Agkistrodontini*; *Calloselasma rhodostoma*; *Calloselasma annamensis*.